THE INTERACTION OF DIETARY LYSINE LEVEL AND DIVERGENT GROWTH GENOTYPES IN GROWING-FINISHING PIGS

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Story in Brief

The effect of increasing levels of dietary lysine was examined in four lines of pigs selected for different postweaning growth criteria. The selection criteria were increased gain under ad libitum intake (F), increased gain under limited intake (L), decreased gain (S) and an unselected control (C). A total of 1,499 barrows and gilts from these lines were fed a diet of either the recommended level of lysine or one that contained .05% or .10% above the recommended level. Carcass data were collected on 247 barrows randomly selected. Significant line by level of lysine interactions were observed for both the growing and finishing phase average daily gain. Performance increased with increasing lysine level in the F and L lines. This interaction was not observed for any of the other performance or carcass parameters analyzed. Level of lysine differences were significant for growing phase feed:gain and daily intake and finishing phase feed:gain. No significant differences due to lysine level were observed for any of the carcass parameters examined. These data suggest that increasing lysine level improved efficiency and decreased intake across lines and increased daily gain of the F and L lines during the growing phase.

(Key Words: Swine, Genotype, Lysine, Growth, Composition.)

Introduction

Lysine is the first limiting amino acid in most swine diets. Amino acids are important because they are the basic units or "building blocks" of protein and are essential for lean growth. Currently the Nutrient Research Council (NRC, 1988) recommends .75% dietary lysine for growing pigs from 45 to 110

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lb and .60% for finishing pigs from 110 lb to market weight. These recommendations do not take into account genetic difference in potential for lean and fat growth.

The objective of this study was to determine the response in growth and carcass characteristics of four lines of pigs selected for differing postweaning growth criteria to increasing levels of dietary lysine.

Materials and Methods

Four lines of pigs selected for different postweaning growth criteria were assigned to one of three diets that varied in lysine level. Lines were selected for: rapid postweaning gain under ad libitum intake (F), rapid postweaning gain under 83% of predicted intake (L), slow postweaning gain (S), and an unselected control (C). The diets were a control that contained .75 and .62% lysine for the growing and finishing phases, respectively (0), .05% additional lysine in each phase (+.05) and .10% additional lysine in each phase (+.10) (Table 1).

Table 1. Composition of the control diets[a].

Ingredient	Growing[b]	Finishing[c]
Corn	76.86	82.32
Soybean meal, 44%	19.53	1.30
Dicalcium phosphate	1.64	1.50
Calcium carbonate	.82	.82
Salt	.40	.40
Vitamin-trace mineral	.25	.25
Tylan 10	.50	.10

[a] Lysine levels of the two treatment diets were increased by replacing corn with lysine hydrochloride (1.28 and 2.55 lb for +.05 and +.10, respectively)

[b] Balanced to .75% lysine.

[c] Balanced to .62% lysine.

The selection lines were replicated in spring and fall farrowing replicates. Diets were assigned in two years of the spring replicate and one year of the fall replicate. Barrows and gilts were placed on test in confinement facilities at nine weeks of age. Diets were assigned to a pen that contained between 14 and 18 barrows and gilts from the same selection line. A pen was switched from the growing to the finishing diet when the pen averaged 120 lb and individual pigs were removed from test at the first weekly weighing of at least 220 lb. Total pen feed consumption was recorded for the growing and finishing phases separately. As pigs were removed from test they were ultrasonically probed at the shoulder, last rib and last lumbar vertebra. One barrow from each litter was randomly chosen for slaughter. A total of 90 pens that included 1,499 barrows and gilts were tested over the three groups. In addition, 247 barrows were slaughtered and various carcass measurements taken. Percent carcass lean and lean gain per day on test were estimated using prediction equations suggested for ribbed carcasses (Weber, 1987).

The data were analyzed by a least squares procedure that accounted for the effects of selection line, dietary level of lysine, sex, year within replicate and all appropriate interactions.

Results and Discussion

Least squares means by line for growth, intake, efficiency and probed backfat are presented in Table 2. The S is the most unique of the four lines. When comparing S to the other three lines they had decreased intake, growth rate and backfat, but were not different in efficiency. Similar results were reported by Woltmann et al. (1989) when comparing the F and S lines. The carcasses of S were more desirable than the other three lines (Table 3), in that they had larger loin eyes, less backfat and higher percentages of carcass lean. Lean gain per day on test was lower for S, however this difference was not as great as for overall daily gain. The F had a 17% higher lean gain than the S, while there was a 29 and 37% difference in overall daily gain for the growing and finishing period, respectively. Similar percentage differences were present when comparing these traits in the S and the other two lines.

A significant ($P<.01$) line by lysine level interaction was observed for daily gain in both the growing and finishing phases (Tables 4 and 5). In the growing phase the two lines selected for increased growth (F and L) responsed to increasing levels of lysine. For the finishing phase no consistent trends for level of lysine were observed within line. This suggests that the F and L lines have an increased lysine requirement for the growing period. This may be due to a relatively higher lean growth rate in these lines during this early growth period.

Table 2. Least squares means by line[c] for growth, intake, efficiency and probed backfat.

	C	F	L	S
Growing phase gain[a]	1.76	1.78	1.72	1.38
Finishing phase gain[a]	2.04	2.15	2.08	1.57
Growing phase intake[a]	4.60	4.67	4.44	3.61
Finishing phase intake[a]	6.87	7.32	6.97	5.27
Growing phase feed:gain	2.62	2.65	2.60	2.64
Finishing phase feed:gain	3.46	3.50	3.42	3.49
Probed average backfat[b]	1.31	1.29	1.19	.98

[a] Lb/day.
[b] Ultrasonically probed backfat in inches adjusted to 230 lb.
[c] C=unselected control, F=selected for rapid postweaning gain under ad libitum intake, L=selected for rapid postweaning gain under limited intake and S=selected for slow postweaning gain.

Table 3. Least squares means by line[d] for carcass parameters.

	C	F	L	S
Average backfat[a]	1.43	1.33	1.29	1.21
Loin eye area[b]	4.47	4.41	4.46	4.87
Percent lean	45.1	46.1	46.8	49.3
Lean gain[c]	.69	.73	.70	.63

[a] Carcass backfat in inches adjusted to 230 lb.
[b] Square inches adjusted to 230 lb.
[c] Estimated lean gain while on test in lb/day.
[d] C=unselected control, F=selected for rapid postweaning gain under ad libitum intake, L=selected for rapid postweaning gain under limited intake and S=selected for slow postweaning gain.

Table 4. Average daily gain (lb/day) least squares means for the interaction of line by level of lysine for the growing phase[a].

	Diet[c]		
Line[b]	0	+.05	+.10
C	1.81	1.80	1.67
F	1.76	1.76	1.82
L	1.68	1.73	1.76
S	1.34	1.42	1.38

[a] Line by level of intake interaction significant (P<.01).
[b] C=unselected control, F=selected for rapid postweaning gain under ad libitum intake, L=selected for rapid postweaning gain under limited intake and S=selected for slow postweaning gain.
[c] Percent additional lysine compared to the control diet.

Table 5. Average daily gain (lb/day) least squares means for the interaction of line by level of lysine for the finishing phase[a].

	Diet[c]		
Line[b]	0	+.05	+.10
C	2.06	1.98	2.08
F	2.14	2.16	2.15
L	2.13	2.04	2.06
S	1.54	1.65	1.54

[a] Line by level of intake interaction significant (P<.01).
[b] C=unselected control, F=selected for rapid postweaning gain under ad libitum intake, L=selected for rapid postweaning gain under limited intake and S=selected for slow postweaning gain.
[c] Percent additional lysine compared to the control diet.

The interaction of line by lysine level was not significant (P>.10) for any of the intake and efficiency traits. Significant differences for level of lysine was observed for growing phase intake and feed:gain (P<.06) and finishing phase feed:gain (P<.07). In general, intake decreased and efficiency improved with increasing levels of lysine.

Effects of level of lysine and the line by level of lysine interaction were not significant for the carcass parameters examined (Table 7).

These results indicate genotype has an effect on lysine requirements. This may be related to the genetic potential for intake. Daily lysine requirements are an absolute amount, but are commonly expressed as a percentage of the diet. To meet these daily requirements it is assumed that the pig will eat a minimum amount of feed. The percentage lysine requirement of a genotype will be determined by both the absolute lysine requirement and the genetic potential for intake.

Table 6. Least squares means by diet for growth and performance traits.

	Diet[d]		
	0	+.05	+.10
Growing phase intake[ab]	4.36	4.43	4.21
Finishing phase intake[a]	6.61	6.68	6.52
Growing phase feed:gain[b]	2.66	2.64	2.58
Finishing phase feed:gain[c]	3.47	3.51	3.42

[a] Lb/day.
[b] Diet effects significant (P<.06).
[c] Diet effects significant (P<.07).
[d] Percent additional lysine compared to the control diet.

Table 7. Least squares means by diet for carcass parameters.

	Diet[d]		
	0	+.05	+.10
Average backfat[a]	1.31	1.33	1.31
Loin eye area[b]	4.48	4.57	4.61
Percent lean	46.7	47.0	46.7
Lean gain[c]	.69	.69	.68

[a] Carcass backfat in inches adjusted to 230 lb.
[b] Squares inches adjusted to 230 lb.
[c] Estimated daily lean gain in lb/day.
[d] Percent additional lysine compared to the control diet.

Literature Cited

NRC. 1988. Nutrient Requirements of Swine (9th Ed.). National Academy Press, Washington, DC.

Weber, G.M. 1987. Guidelines for uniform swine improvement programs. USDA program aid.

Woltmann, M.D. et al. 1989. Characteristics of pigs selected for rapid or slow and fed ad libitum or limited rations. Okla. Agr. Exp. Sta. Res. Rep. MP-127:32.